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MOTOR VEHICLE HAVING A BRAKE SYSTEM AND A DRIVE SYSTEM

The invention relates to a motor vehicle having a brake system and a drive system, wherein the brake system is composed of: a vehicle movement dynamics controller, an electronic control group for wheel-specific actuation of brakes and a hydraulic unit with pressure medium supply and wheel-specific hydraulic valves, combined to form one assembly, for activating the individual wheel brake cylinders, and wherein the drive system has at least one drive train which has the purpose of driving the wheels and in which a controllable clutch is arranged, which clutch is activated by a clutch controller as a function of operating variables using a clutch actuation means and a hydraulic valve for acting on its hydraulic actuator.

Brake systems with wheel-specific hydraulic valves for activating the individual wheel brake cylinders are a recent development and are particularly suitable for applying modern driving aids such as ABS (anti-lock brake controller), ETC (electronic traction control) and ESP (electronic stability program). They may be, for example, electro-hydraulic brake systems (often referred to in specialist literature in abbreviated form as "EHB"), such as is described, for example, in DE 199 23 689 A1.

The drive system may comprise one or more drive trains, corresponding to a vehicle with one or more driven axles. In the first case, the controllable clutch has the purpose of locking the axle differential which is continuously variable in accordance with the requirements of vehicle movement dynamics. In the second case, it can be used for connecting the further driven axle or locking a central differential mechanism (also referred to as inter-axle differential) in a continuously variable fashion, or for controlling the distribution of torque between the two axles.

In the drive systems of this type mentioned above, the clutch, or the clutches, each have a separate functional group with a separate power source and a separate control device which retrieves the operating data of the vehicle from a bus (this is usually a CAN bus) and calculates the necessary clutch position from said data and then correspondingly actuates the clutch. Most of this operating data together with other data, including that from the vehicle movement dynamics controller of the brake system, is used and therefore obtained from the same bus.

Furthermore, in many situations the brake system must be matched to the clutch control. This means that two separate systems have to communicate with one another, the data between the two controllers, which are usually programmed processors, being connected and exchanged via interfaces, coding/decoding means and the bus. This is a

source of errors and also requires time which is always critical in vehicle movement dynamics control operations. Furthermore, the expenditure on control and activation is considerable, both in logistical terms and also because the safety requirements which are made of the clutch control require a minimum level of expenditure which exceeds the scope of pure control functions, which is small in itself.

Although DE 37 21 626 discloses a motor vehicle with first-generation four-wheel drive in which the master brake cylinder of a brake device acts on the wheel brakes of the wheels and also the actuating element of a clutch is activated, the brake device is purely hydraulic and therefore does not have any electronically actuated, wheel-specific hydraulic valves. The clutch is only used to disconnect the drive connection during braking and cannot be actuated in a variable fashion.

It is therefore the object of the invention to make the vehicle as a whole cheaper while at the same time improving it functionally. For this purpose, according to the invention, the clutch controller of the drive system is integrated into the vehicle movement dynamics controller of the brake system, and the hydraulic valve for activating the clutch is connected to the pressure medium supply of the brake system and is part of the hydraulic valve assembly.

As a result, not only are two times two similar systems combined to form only one system in each case, but

also the communication between the two controllers is exported into the program of the now single controller, as it were internalized, as a result of which a source of errors is eliminated and time is gained. In practical terms, this means that, when the invention is implemented on the hardware of the vehicle movement dynamics controller, no changes at all are necessary and it is sufficient to adapt the program, usually only in a few details. This also satisfies the stringent safety requirements for the control of the brake system.

The common pressure medium supply of the brake system and clutch initially allows the system to be made considerably cheaper because a pump together with drive, valves and lines is eliminated. Electrohydraulic brake systems have a high-pressure accumulator in all cases so that sufficient pressure medium is available even when there is synchronism. In addition, there is the fact that the actuators are the same in terms of force and displacement, which is an advantage for the supply by means of only one power source. Electrohydraulic brake systems thus make it possible to overcome the prejudice that a brake system has to be independent in terms of safety. As a result of the fact that the hydraulic valve for the clutch is also part of this assembly, the degree of integration of the two systems is increased, usually even entirely without additional expenditure if the modular valve blocks which are used as an

assembly contain a reserve unit ("virtual fifth wheel"). The valves and lines which are used for brake systems satisfy the most stringent safety requirements and also satisfy the requirements of the clutch control even more easily.

In a completed development, the clutch actuation means is also integrated into the electronic control group (claim 2). This is usually also of modular design and is composed of the drivers which convert the signals coming from the vehicle movement dynamics controller into control current for the control valves. Here too, use is made of the modularity of this assembly.

The invention is described and explained below with reference to illustrations, in which:

fig. 1 is a rough outline of the invention, and

fig. 2 is a schematic view of an electrohydraulic brake system having the system which is integrated according to the invention.

Fig. 1 illustrates, for example, a vehicle with an engine transmission block 1 arranged transversely at the front. However, this is irrelevant to the invention and the invention can pretty well be applied with any other configuration of the drive mechanism. The engine transmission block 1 is connected to the wheels 4 of the front axle via a front axle differential mechanism 2 and the half shafts 3. This connection forms a first very short drive train. A Cardan shaft 5 leads from the front axle differential

mechanism 2 via a clutch 6, a rear axle differential mechanism 7 and rear half shafts 8 to the wheels 9. This constitutes a second drive train. The controllable clutch 6 which is contained in the second drive train has the purpose of controlling the distribution of torque between the front axle and the rear axle. The drive force could equally well be distributed from the engine transmission block 1 via a central differential mechanism (not illustrated) to the two axle differential mechanisms 2, 7. In this case, the controllable clutch would be an adjustable differential lock.

The brake system is composed of a vehicle movement dynamics controller 10, a control group, designated here in its entirety by 11, with valves (not illustrated), from which wheel brake cylinders 12 (also indicated) are activated via brake lines 13 (provided with indices in the figure). The clutch actuation means 14 is indicated here as an attachment of the control group 11, a pressure line 15 leading from it to the actuator 16 of the clutch 6.

Fig. 2 illustrates in somewhat more detail the brake system which is combined with the clutch control in the embodiment with the maximum degree of integration. An activation unit which is designated in its entirety by 20 is composed of a brake pedal 21, a brake request sensor 22, from which a signal line 23 leads to the vehicle movement dynamics controller 10, of a brake cylinder 24, which has the purpose of simulating a pedal stroke and providing fail-safety, and a

fluid vessel 25. The fluid vessel 25 is already part of the pressure medium supply. From said vessel 25, a suction line 26 leads to a fluid pump 27 which is driven by a motor 28. The control of the pump 27 and the associated valves are not illustrated. A pressure line 30 leads to the control group 11 on the delivery side of the pump 27 and has a pressure accumulator 29 in the bypass flow. A return line 31 leads back to the fluid vessel 25 from the control group.

The vehicle movement dynamics controller 10 of the brake system is programmed as a processor in such a way that it can also assume the function of a clutch controller since all the measurement variables which are relevant for driving and operating states are fed to it, for example the brake request signal of the driver (line 23) or the rotational speed signals of the wheel speed sensors 34 - which are provided again with the corresponding indices in fig. 2 - via the line 33. Further variables are the steering angle, acceleration values, etc. All these signals are generated in the vehicle movement dynamics controller 10 to form control variables for the brake forces or the brake pressures and for the torque which is transmitted by the clutch 6. These control signals 39 are fed to the control group 11 which is designated in its entirety by 11.

The control group 11 is composed of an electronic control group 40 which is of modular design and in which the actuation signals 39 are converted into switching currents

which are fed via lines 41 into a valve group 43 which is also of modular design. The modular design consists in the fact that each module is assigned to a wheel, and these are correspondingly provided with indices in fig. 2. In addition to the 4 modules which are assigned to the individual wheel brakes, a further module 40 for the clutch actuating means is provided as, as it were, a fifth wheel on the vehicle. In many cases, a reserve module, which is normally unused, is already provided in control groups according to the prior art. The object according to the invention may be allocated to this reserve module. In the modular valve group 43, the individual modules are again provided with the corresponding indices, and in each case a hydraulic valve switches, under the control of the control stream 41, the pressurized fluid stream which is conducted from the pressure line 30 to the wheel brake cylinders 12. For this reason, the return line 31 is also connected there.